WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a metal wiring provided on a semiconductor substrate;

an anti-metal diffusion film formed on the metal wiring;

a buffer layer which is formed on the anti-metal diffusion film and includes at least a silicon-methyl radical bond and a silicon-oxygen bond; and

a low-dielectric constant film layer which is formed on the buffer layer and includes at least the silicon-methyl radical bond and the silicon-oxygen bond,

wherein the silicon-methyl radical bonding density of the buffer layer is less than the silicon-methyl radical bonding density of the low-dielectric constant film layer.

2. A semiconductor device according to claim 1, wherein a film thickness of the buffer layer is not more than 30 nm.

3. A semiconductor device according to claim 1, wherein a specific dielectric constant of the low-dielectric constant film layer is not more than 3.1.

4. A semiconductor device according to claim 1, wherein a silicon-methyl radical bonding density relative to a silicon-oxygen bond in the buffer layer is not less than 22%.

5. A semiconductor device according to claim 1, wherein a silicon-methyl radical bonding density relative to a silicon-oxygen bond in the low-dielectric constant film layer is not less than 25%.

6. A semiconductor device according to claim 1, wherein the metal wiring is a copper wiring, and the copper wiring is embedded in a surface portion of an insulating film layer provided on the semiconductor substrate having an element devices formed thereto.

7. A semiconductor device according to claim 1, wherein the anti-metal diffusion film is a methyl radical-containing silicon nitride film.

8. A semiconductor device according to claim 1, wherein the anti-metal diffusion film is a methyl radical-containing silicon carbide film.

9. A semiconductor device according to claim 1, wherein the anti-metal diffusion film is a laminated film of a methyl radical-containing silicon nitride film and a methyl radical-containing silicon carbide film.

10. A semiconductor device according to claim 1, wherein the buffer layer is a first methyl radical-containing silicon oxide film formed by using an organic silicon compound containing a methyl radical as a raw material.

11. A semiconductor device according to claim 1, wherein the low-dielectric constant film layer is

a second methyl radical-containing silicon oxide film formed by using an organic silicon compound containing a methyl radical as a raw material.

12. A semiconductor device according to claim 1, further comprising an upper metal wiring layer which is connected to the metal wiring through the low-dielectric constant film layer, the buffer layer and the anti-metal diffusion film.

13. A manufacturing method of a semiconductor device comprising:

forming an anti-metal diffusion film on a metal wiring provided on a semiconductor substrate; and

forming a buffer layer including at least a silicon-methyl radical bond and a silicon-oxygen bond on the anti-metal diffusion film and forming a low-dielectric constant film layer including at least the silicon-methyl radical bond and the silicon-oxygen bond on the buffer layer,

wherein the buffer layer is formed in such a manner that its silicon-methyl radical bonding density is less than the silicon-methyl radical bonding density of the low-dielectric constant film layer.

14. A method according to claim 13, wherein a film thickness of the buffer layer is controlled to be not more than 30 nm.

15. A method according to claim 13, wherein a specific dielectric constant of the low-dielectric

constant film layer is controlled to be not more than 3.1.

16. A method according to claim 13, wherein the buffer layer is film-formed in such a manner that a silicon-methyl radical bonding density relative of a silicon-oxygen bond is not more than 22%.

17. A method according to claim 13, wherein the buffer layer is formed under a pressure being controlled to be not more than 3 torr during the film formation.

18. A method according to claim 13, wherein the buffer layer is formed by an RF (Radio Frequency) power density being controlled to be not less than 2 W/cm^3.

19. A method according to claim 13, wherein a flow rate ratio of the methyl radical-containing organic silicon compound and oxygen is controlled to be 1:5 during the buffer layer formation.

20. A method according to claim 13, wherein the low-dielectric constant film layer is formed in such a manner that a silicon-methyl radical bonding density relative to a silicon-oxygen bond is not less than 25%.

21. A method according to claim 13, wherein the metal wiring is a copper wiring, and the copper wiring is embedded in a surface portion of an insulating film layer provided on the semiconductor substrate having element devices formed thereto.

22. A method according to claim 13, wherein

a methyl radical-containing silicon nitride film is used for the anti-metal diffusion film.

23. A method according to claim 13, wherein a methyl radical-containing silicon carbide film is used for the anti-metal diffusion film.

24. A method according to claim 13, a laminated film of a methyl radical-containing silicon nitride film and a methyl radical-containing silicon carbide film is used for the anti-metal diffusion film.

25. A method according to claim 13, wherein the buffer layer and the low-dielectric constant film layer are formed by using an organic silicon compound containing a methyl radical as a raw material.

26. A method according to claim 25, wherein the buffer layer and the low-dielectric constant film layer are continuously formed without turning off a power supply.

27. A method according to claim 13, wherein the buffer layer and the low-dielectric constant film layer are discontinuously formed by turning on a power supply again.